

REMARKS/ARGUMENTS

Claims 1-17 are pending. Claims 1 and 2 have been amended, claims 16 and 17 have been added, and claims 3-15 remain unchanged. Support for the amendments to claims 1 and 2 can be found in the specification, for example, at page 1, lines 5 to 7 and page 16, lines 23 to 27. Support for new claims 16 and 17 can be found in the specification, for example, at page 16, lines 2 to 5 of the specification. No new matter has been added. Favorable consideration is requested.

Claims 1-15 have been rejected under 35 U.S.C. 112, second paragraph, because the claimed terms “one minute half life temperature” and “10-hour half life temperature” allegedly render the scope of the invention indefinite. The applicants respectfully traverse the rejection.

The definitions of the claimed terms “one minute half life temperature” and “10-hour half life temperature” are described at pages 9 and 12 of the specification. The terms have also been known as “one minute half-life decomposition temperature” and “ten-hour half life decomposition temperature.” It is well known in the art that the thermal stability of a composition is represented by half life temperatures. Chemical compounds, such as peroxides, have half life temperatures designated as one minute half life temperatures, one hour half life temperatures, and 10-hour half life temperatures. See Exhibit A (col. 16, lines 35 to 44 of U.S. Patent 5,679,719), Exhibit B (paragraph [0079] of U.S. 2004/0024157A1), and Exhibit C (<http://222.2qako-chem.co.jp/specialty/oilazo/main.htm>). Various methods are also well known in the art to determine half life temperatures, for example, DSC. Thus, applicants submit that the claims are definite and that it is not necessary to recite conditions of measurement of the temperatures in claims.

Claims 1-15 have been rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Medalia et al (U.S. Patent 3,105,057). Applicants respectfully request the withdrawal of the rejection for the following reasons.

Claims 1 and 2 include heating a mixture containing a peroxide and an ethylene- α -olefin copolymer without causing cross-linking of the ethylene- α -olefin copolymer. The prior art does not disclose or suggest the claimed invention. In fact, the prior art teaches away from the claimed invention. More specifically, Medalia teaches the heating of copolymers in order to cross-link the copolymers. See paragraphs starting from col. 1, line 55 to col. 2, line 19. There would be no motivation to modify the heating step of Medalia to preclude the cross-linking reaction of the copolymers -- because doing so would be contrary to the teachings of Medalia. Thus, claims 1 and 2 are patentable over Medalia.

In view of the foregoing amendments and remarks, applicants submit that the application is in condition for allowance. A notice to that effect is earnestly solicited.

If the examiner has any questions concerning this case, the undersigned may be contacted at 703-816-4009.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: _____



Duane M. Byers
Reg. No. 33,363

DMB:lfo
901 North Glebe Road, 11th Floor
Arlington, VA 22203-1808
Telephone: (703) 816-4000
Facsimile: (703) 816-4100

in vinyl monomers. As used herein, the term "(meth)acrylic" is intended to be broadly construed to include acrylic as well as methacrylic compounds, e.g., acrylic esters and methacrylic esters.

It is preferred that the polyolefinically unsaturated monomer have a low viscosity to offset the effect of any higher viscosity component so as to retain the low composition viscosity required for effective filament winding. In addition, the polyolefinically unsaturated monomer component may comprise one or more low viscosity monoolefinically unsaturated monomers as diluents, but in any event, the olefinically unsaturated monomer component must comprise at least one polyolefinically unsaturated monomer. As used herein "polyolefinically unsaturated" means having at least two olefinic double bonds. The polyolefinically unsaturated monomers may be used in amounts of about 5% to about 30% and preferably about 10% to 20% by weight of the composition.

Polyacrylates are generally useful, including 1,3-butylene glycol diacrylate, diethylene glycol diacrylate, 1,6-hexanediol diacrylate, neopentylglycol diacrylate, polyethylene glycol diacrylate, tetraethylene glycol diacrylate, methylene glycol diacrylate, pentaerythritol tetraacrylate, tripropylene glycol diacrylate, ethoxylated bisphenol-A diacrylate, trimethylolpropane triacrylate, di-trimethylolpropane tetraacrylate, dipenterythritol pentaacrylate, pentaerythritol triacrylate and the corresponding methacrylate compounds. Also useful are reaction products of (meth)acrylic acid and epoxide resins, and urethane resins. Suitable poly(meth)acrylic ester compounds are also described in U.S. Pat. Nos. 4,051,195, 2,895,950, 3,218,305, and 3,425,988.

Useful (meth)acrylic resins include esters and amides of (meth)acrylic acid as well as comonomers thereof with other copolymerizable monomers. Illustrative esters include methyl acrylate, methyl methacrylate, hydroxy ethyl acrylate, butyl methacrylate, octyl acrylate, and 2-epoxy ethyl acrylate. Illustrative amides include bytoxymethyl acrylamide, methoacrylamide, and t-butyl acrylamide. Also suitable are copolymers of such compounds, and copolymers with other monomers containing polymerizable vinyl groups.

Another class of resins which are actinic radiation curable and potentially suitable for use in the compositions in the invention include vinyl monomers such as styrene, vinyl toluene, vinyl pyrrolidone, vinyl acetate, divinyl benzene, and the like.

A further useful class of actinic radiation curable resin materials comprises unsaturated polyesters, solubilized in vinyl monomers, as ordinarily prepared from alpha-beta ethylenically unsaturated polycarboxylic acids and polyhydric alcohols, as described for example in U.S. Pat. No. 4,025,407.

Particularly preferred polyolefinically unsaturated components include trimethylolpropane trimethacrylate, trimethylolpropane triacrylate, dipentaerythritol pentaacrylate, pentaerythritol triacrylate, ethoxylated trimethylolpropane triacrylate, 1,6 hexanediol diacrylate, neopentyl glycol diacrylate, pentaerythritol tetraacrylate, and 1,3 butylene glycol diacrylate. Preferred monoacrylates include cyclohexylacrylate, 2-ethoxyethyl acrylate, 2-methoxyethyl acrylate, benzoyl acrylate, and isobornylacrylate. Such compounds are available from a variety of sources. For example, a preferred polyacrylate, dipentaerythritol monohydroxypentaacrylate is available as SR 399 from Sartomer Co.

It will be understood by those skilled in the art that the foregoing listing of polyolefinically unsaturated compounds

is intended only to be illustrative in character, and that any other resin compounds having such functionality in their molecules and curable under actinic radiation conditions may potentially be employed. In addition to those monomers required to be present, other optional monomers may be present which have both acrylate and epoxy functionality ("dual-functional" monomers).

As used herein, "actinic radiation" means electromagnetic radiation having a wavelength of about 700 nm or less which is capable, directly or indirectly, of curing the specified resin component of the resin composition. By indirect curing in this context is meant curing under such electromagnetic radiation conditions, as initiated, promoted, or otherwise mediated by another compound.

Accordingly, a non-peroxide photoinitiator is added to the composition in an amount effective to respond to the actinic radiation and to initiate and induce curing of the associated resin, via substantial polymerization thereof.

Suitable photoinitiators useful with ultraviolet (UV) actinic radiation curing mono- and polyolefinic monomers include free radical generating UV initiators such as substituted benzophenones and substituted acetophenones, benzoin and its alkyl esters and xanthone and substituted xanthenes. Preferred photoinitiators include diethoxyacetophenone, benzoin methyl ether, benzoin ethyl ether, benzoin isopropyl ether, diethoxyxanthone, chloro-thioxanthone, azo-bisisobutyronitrile, N-methyl diethanolamine-benzophenone and mixtures thereof.

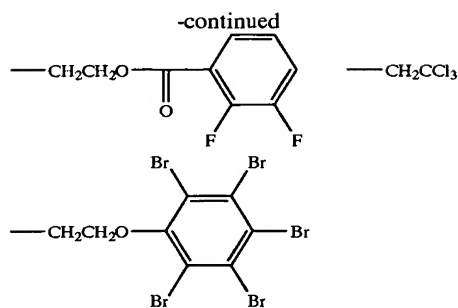
Particularly preferred photoinitiators include 2-hydroxy-2-methyl-1-phenyl-propan-1-one available as Darocur 1173 from EM Industries, Inc., and 2-benzyl-2-(dimethylamino)-1-[4-(4-morpholinyl)phenyl]-1-butanone available as Irgacure 369 from Ciba-Geigy.

The present invention requires the use of organic peroxides having 10 hour decomposition half-lives (10 hr. $T_{1/2}$) at temperatures of from about 50° C. to less than about 104° C. Peroxides having 10 hour decomposition half-lives at temperatures below this range do not yield compositions which have stable pot-life and shelf-life characteristics. Peroxides having 10 hour decomposition half-lives at temperatures above this range have not been found to be effective in preventing resin drip during the heat cure stage. The peroxides useful in the present invention are not useful in themselves as photoinitiators.

These peroxides include various diacylperoxides such as diisononanoyl peroxide, decanoyl peroxide, lauroyl peroxide, succinic acid peroxide and benzoyl peroxide.

Also useful are various peroxydicarbonates such as di(n-propyl)peroxydicarbonate, di(sec-butyl)peroxydicarbonate, and di(2-ethylhexyl)peroxydicarbonate.

Further useful peroxides include various peroxyesters such as α -cumylperoxyneodecanoate, 1,1-dimethyl-3-hydroxy-butylperoxyneohexanoate, α -cumylperoxyneohexanoate, t-amyl-peroxyneodecanoate, t-butylperoxyneodecanoate, t-amyl-peroxypivalate, t-butylperoxypivalate, 1-1-dimethyl-3-hydroxy-butylperoxy-2-ethylhexanoate, 2,5-dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane, t-amylperoxy-2-ethylhexanoate, t-butylperoxy-2-ethylhexanoate, t-butylperoxyisobutyrate, t-butylperoxymaleic acid, t-butylperoxyacetate, t-amylperoxyacetate, t-amylperoxybenzoate, OO-t-butyl-O-isopropylmonoperoxycarbonate, 2,5-dimethyl-2,5-di(benzoylperoxy)hexane, OO-t-butyl-O-(2-ethylhexyl)monoperoxycarbonate, OO-t-amyl-O-(2-ethylhexyl)monoperoxycarbonate.



[0074] The polymer preferably used for the core region is a homopolymer or copolymer containing repetitive unit (1), (2) or (3) out from the exemplary repetitive units listed in the above. While specific examples of the polymers available for forming the clad region are also the same as described in the above, additional specific examples thereof include a homopolymer containing only fluorine atoms as the substituent (e.g., unit (10)) selected from the exemplary repetitive units (1) to (34) listed in the above, and a copolymer of a repetitive unit containing only fluorine atoms as the substituent (e.g., unit (25)) and a repetitive unit containing neither deuterium atoms nor halogen atoms in an arbitrary ratio. In particular for the clad region, homopolymers or copolymers containing the foregoing repetitive units (8), (10) or (25) are preferable.

[0075] In the third embodiment, specific examples of the low-molecular-weight organic compound (refractive index adjusting agent) to be contained in the core region are as described in the above. The refractive index can be adjusted to a desired value by controlling the concentration and distribution of the low-molecular-weight organic compound in the core region. The amount of addition thereof is properly selected depending on purpose of use and a source material for the core region to be combined with. Also in the fourth embodiment, the low-molecular-weight organic compound (refractive index adjusting agent) can be included in the core region so as to further ensure formation of refractive-index-distributed structure.

[0076] When the monomers as the source materials for the core region and clad region are polymerized, it is allowable to add a polymerization initiator or polymerization modifier (e.g., chain transfer agent) for the purpose of controlling the molecular weight suitable for heat stretching. Specific examples of the polymerization initiator and polymerization modifier are as described in the above.

[0077] Next paragraphs will describe examples of producing method of the third and fourth embodiments will be explained, however, the methods is not limited to the examples shown below.

[0078] Either the third or fourth embodiment can be produced by a method comprising a first step of producing a hollow structure (for example a cylinder) corresponding to the clad region; a second step of producing a preform which comprises areas respectively corresponded to the core region and clad region by carrying out polymerization of a polymerizable composition in the hollow portion of the structure; and a third step of processing the obtained preform into

various forms. The polymerizable composition use in the second step may comprise a deuterated and halogenated (preferably fluorinated) propenoic acid ester based polymer (for example (meth)acrylate based polymer), a polymerization initiator, and a polymerization modifier for controlling a molecular weight of the obtained polymer. In case of the third embodiment, the composition contains a low molecular weight organic compound having the refractive index different from that of the ester, in case of the fourth embodiment, the composition contains two or more polymerization monomers that there is 0.05 and more disparity in refraction indices of homopolymers made of each the monomers, In the first step, a hollow structure (for example cylinder) made of a polymer is obtained. As typically described in International Patent Publication WO93/08483, a polymerizable composition containing the ester (for example a deuterated and halogenated (meth)acrylate) is put into a cylindrical polymerization vessel, and then polymerization is carried out while rotating (preferably while keeping the axis of the cylinder horizontally) the vessel to thereby form a cylinder made of a polymer. The other monomers and/or a polymerization initiator may be added to the vessel. A chain transfer agent is preferably used in the polymerization in order to control the molecular weight of an obtained polymer, thereby being in a range of 40,000 to 120,000. The composition used herein may be pre-polymerized before the polymerization so as to raise the viscosity thereof as described in JP-A No. 8-110419.

[0079] It is desirable to use a compound as a polymerization initiator, of which ten-hour, half-life decomposition temperature is equal to or lower than a boiling point of the monomer. It is to be noted now that ten-hour, half-life decomposition temperature ($t_{1/2}$ ° C.) of the polymerization initiator means a temperature at that the polymerization initiator decomposes and reduces to the half amount for ten hours. It is more preferable to use the compound as a polymerizing initiator and to carry out the polymerization in the presence of the initiator at temperature of the range form $\{(t_{1/2})-20\}$ ° C. to $t_{1/2}$ ° C.

[0080] For the case where 2,2,2-trifluoroethyl-pentadeuterium methacrylate ($\text{CD}_2=\text{C}(\text{CD}_3)\text{CO}_2\text{CH}_2\text{CF}_3$) is used as the ester monomer and PBD is used as polymerization initiator, the polymerization may be carried out at 100 to 110° C. for 48 to 72 hours.

[0081] A preferable range of the additional amount of the polymerization initiator may properly be determined in consideration of species of the monomer to be employed, however, in general, a desirable additional amount of the polymerization initiator is in a range from 0.10 to 1.00 wt % of the monomer, and more preferably in a range from 0.40 to 0.60 wt %.

[0082] For the purpose of completely reaction of the residual monomer or the residual polymerization initiator, it is allowable after such rotational polymerization to carry out annealing at a temperature higher than the polymerization temperature, or to remove non-polymerized components.

[0083] How dimension of the vessel, how amount of the polymerizable composition, and how many revolutions per unit of time can be determined according to how dimension of desired plastic optical member (or perform) Since the obtained hollow structure may be deformative when the vessel may get distorted by rotation, it is preferable to use a metal or glass vessel having a sufficient rigidity.

EXHIBIT

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